### 6B.6.7.6—Permanent Loads Other Than Dead Loads

Secondary effects from post-tensioning shall be considered as permanent loads.

### C6B.6.7.6

In continuous post-tensioned bridges, secondary moments are introduced as the member is stressed.

## 6B.7—POSTING OF BRIDGES

### 6B.7.1—General

Weight limitations for the posted structure should conform to local regulations or policy within the limits established by this Manual. A bridge should be capable of carrying a minimum gross live load weight of three tons at Inventory or Operating level. When deciding whether to close or post a bridge, the owner may particularly want to consider the volume of traffic, the character of traffic, the likelihood of overweight vehicles, and the enforceability of weight posting. A Bridge Owner may close a structure at any posting threshold, but bridges not capable of carrying a minimum gross live load weight of three tons must be closed.

A concrete bridge need not be posted for restricted loading when it has been carrying normal traffic for an appreciable length of time and shows no distress. This general rule may apply to bridges for which details of the reinforcement are not known. However, until such time as the bridge is either strengthened or replaced, it should be inspected at frequent intervals for signs of distress. In lieu of frequent inspections, a bridge may be load tested to determine its capacity.

The total load on any member caused by dead load, live load, and such other loads deemed applicable to the structure, should not exceed the member capacity as set forth in this Manual or in the rating report. When it becomes necessary to reduce the allowable live loads in order to conform to the capacity of a structure, such a reduction should be based on the assumption that each axle load maintains a proportional relation to the total load of the vehicle or vehicle combination.

### C6B.7.1

Most structures which require weight limits below statutory limits are old and designed for light loads, and/or are weak as a result of damage. With some exceptions, the weaker elements of older bridges are usually in the superstructure, not in the piers or abutments.

There may be circumstances where the Bridge Owner may utilize load levels higher than those used for Inventory rating, in order to minimize the need for posting of bridges. In no case shall the load levels used be greater than those permitted by the Operating Rating.

For those bridges supporting large dead loads, the use of the Load Factor or Load and Resistance Factor rating methods may result in a live load capacity greater than that determined based on the allowable stress rating method.

Bridges which use a load level above the Inventory Level should be subject to more frequent, competent inspections. Several factors may influence the selection of the load level. For instance:

1. The factor of safety commonly used in the design or Inventory level rating may have provided for an increase in traffic volume, a variable amount of deterioration and extreme conditions of live loading.
2. The factor of safety used in rating existing structures must provide for unbalanced distribution of vehicle loads, and possible overloads. For both design and rating, factors of safety must provide for lack of knowledge as to the distribution of stresses, possible minimum strength of the materials used as compared to quoted average values, possible differences between the strength of laboratory test samples and the material under actual conditions in the structure, and normal defects occurring in manufacture or fabrication.
3. A higher safety factor for a bridge carrying a large volume of traffic may be desirable as compared with the safety factor for a structure carrying few vehicles, especially if the former includes a high percentage of heavy loads.
4. The probability of having a series of closely spaced vehicles of the maximum allowed weight should be considered. This effect becomes greater as the maximum allowed weight for each unit becomes less.

5. Lower load levels may be warranted for nonredundant metal bridge elements due to the consequences of failure. Exceptions may be elements of riveted construction and all floor beams, provided they are in good condition. Examples of nonredundant elements are welded or rolled two-girder bridges, truss members, or pinned eyebar trusses and truss members on welded trusses.
6. Bridges with extensive material losses may warrant a lower load level because of the greater uncertainty in evaluating present strength capacity. This is especially true if the loss in material is in a highly stressed area.
7. Sites for which it is suspected that there are frequent truck overloads should be considered for lower load levels unless enforcement methods are put in place.
8. The ratio of dead load to live load may have an influence on the selection of appropriate load level. Structures with high ratios of dead to live load and for which there are no visible signs of distress may be considered for the higher load levels.

### 6B.7.2—Posting Loads

The live load to be used in the rating Eq. 6B.4.1-1 for posting considerations should be any of the three typical legal loads shown in Figure 6B7.2-1, any of the four single-unit legal loads shown in Figure 6B7.2-2 or State legal loads. For spans over 200 feet in length, the selected legal load should be spaced with 30 feet clear distance between vehicles to simulate a train of vehicles in one lane and a single vehicle load should be applied in the adjacent lanes(s). When the maximum legal load under state law exceeds the safe load capacity of a bridge, restrictive posting shall be required.

### C6B.7.2

Trucks weighing up to 80,000 lb are typically allowed unrestricted operation and are generally considered "legal" provided they meet weight guidelines of Federal Bridge Formula B (Formula B). In the past, the maximum legal weight for short wheelbase trucks was usually determined by Formula B rather than by the 80,000-lb gross weight limit. Since the adoption of the AASHTO family of three legal loads, the trucking industry has introduced specialized single-unit trucks with closely spaced multiple axles that make it possible for these short wheelbase trucks to carry the maximum load of up to 80,000 lb and still meet Formula B. The current AASHTO legal loads selected at the time to closely match the Formula B in the short, medium, and long truck length ranges do not represent these newer axle configurations. These specialized hauling vehicles cause force effects that exceed the stresses induced by HS-20 by up to 22 percent and by the Type 3, 3S2, or 3-3 posting vehicles by over 50 percent in certain cases. The shorter spans are most sensitive to axle configurations.

The Notional Rating Load, *NRL*, shown in Figure 6B7.2-3 may be used as a screening load model for single-unit trucks that meet Formula B. Bridges that result in $RF \geq 1.0$ for the *NRL* loading will have adequate load capacity for all legal single-unit Formula B truck configurations up to 80,000 lb.

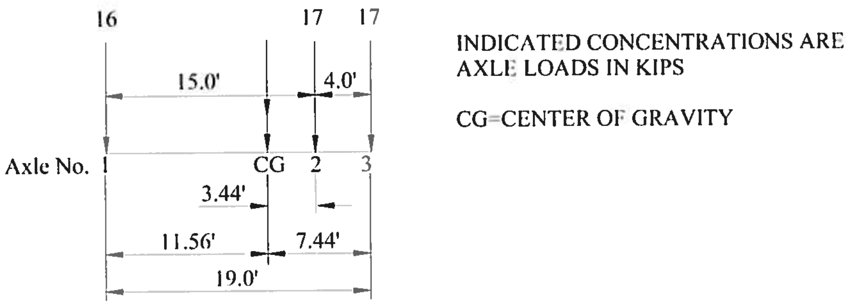
The *NRL* loading represents a single load model that will envelop the load effects on simple and continuous span bridges of the worst possible Formula B single-unit truck configurations up to 80,000 lb. It is called "notional" because it is not intended to represent any particular truck. Vehicles considered to be representative of the newer Formula B configurations were obtained through the analysis of weigh-in-motion data and other truck and survey data obtained from the States. The single *NRL* load model with a maximum gross weight of 80,000 lb produces moments and shears that exceed the load effects for a series of 3- to 8-axle single-unit trucks allowed to operate under current federal weight laws (NCHRP Report 575).

In the *NRL* loading, axles that do not contribute to the maximum load effect under consideration shall be neglected. For instance, axles that do not contribute to the maximum positive moments need to be neglected or they will contribute to bending in the opposite (negative) direction. This requirement may only affect certain continuous bridges, usually with short span lengths. The drive axle spacing of 6 ft may also be increased up to 14 ft to maximize load effects. Increasing the drive axle spacing to 14 ft could result in a slight increase in moments for continuous bridges.

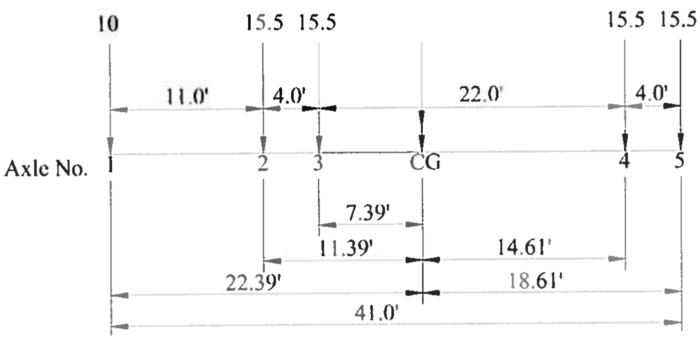
For bridges with $RF < 1.0$ for the *NRL* loading, a posting analysis should be performed to resolve posting requirements for single-unit multi-axle trucks. While a single envelope *NRL* loading can provide considerable simplification of load-rating computations, additional legal loads for posting are needed to give more accurate posting values. Certain multi-axle Formula B configurations that cause the highest load effects appear to be common only in some States, and they should not lead to reduced postings in all States.

Setting weight limits for posting often requires the evaluator to determine safe load capacities for legal truck types that operate within a given State, in accordance with State posting practices. The four single-unit Formula B legal loads shown in Figure 6B.7.2-2 include the worst 4-axle (SU4), worst 5-axle (SU5), worst 6-axle (SU6), and worst 7-axle (SU7) trucks (7-axle is also representative of 8-axle trucks) identified in the NCHRP 12-63 study. This series of loads affords the evaluator the flexibility of selecting only posting loads that model commercial Formula B trucks in a particular State or jurisdiction.

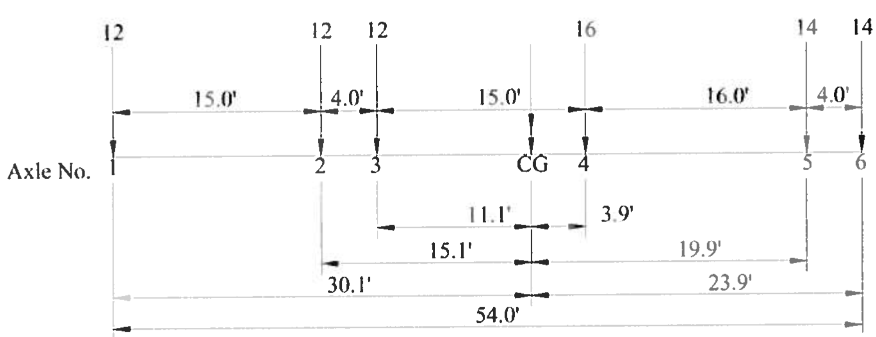
The more compact four- and five-axle trucks that produce the highest moment or shear per unit weight of truck will often govern the posting value (result in the lowest weight limit). States that post bridges for a single tonnage for all single-unit trucks may consider it desirable to reduce the number of new posting loads that need to be evaluated. Here it would be appropriate to use truck SU5 as a single representative posting load for the series of Formula B truck configurations with 5 to 8 axles. This simplification will introduce added conservatism in posting, especially for short-span bridges. It should be noted that situations could arise where a bridge may have a $RF > 1.0$ for SU5 but may not rate ($RF < 1.0$) for SU6 or SU7. Here the SU5 load model is being utilized to determine a single posting load for a bridge that has adequate capacity for SU5 but not for the heavier trucks.




**TYPE 3 UNIT** WEIGHT = 50 KIPS (25 TONS)




**TYPE 3S2 UNIT** WEIGHT = 72 KIPS (36 TONS)




**TYPE 3-3 UNIT** WEIGHT = 80 KIPS (40 TONS)

**Figure 6B.7.2-1—Typical Legal Loads Used for Posting**

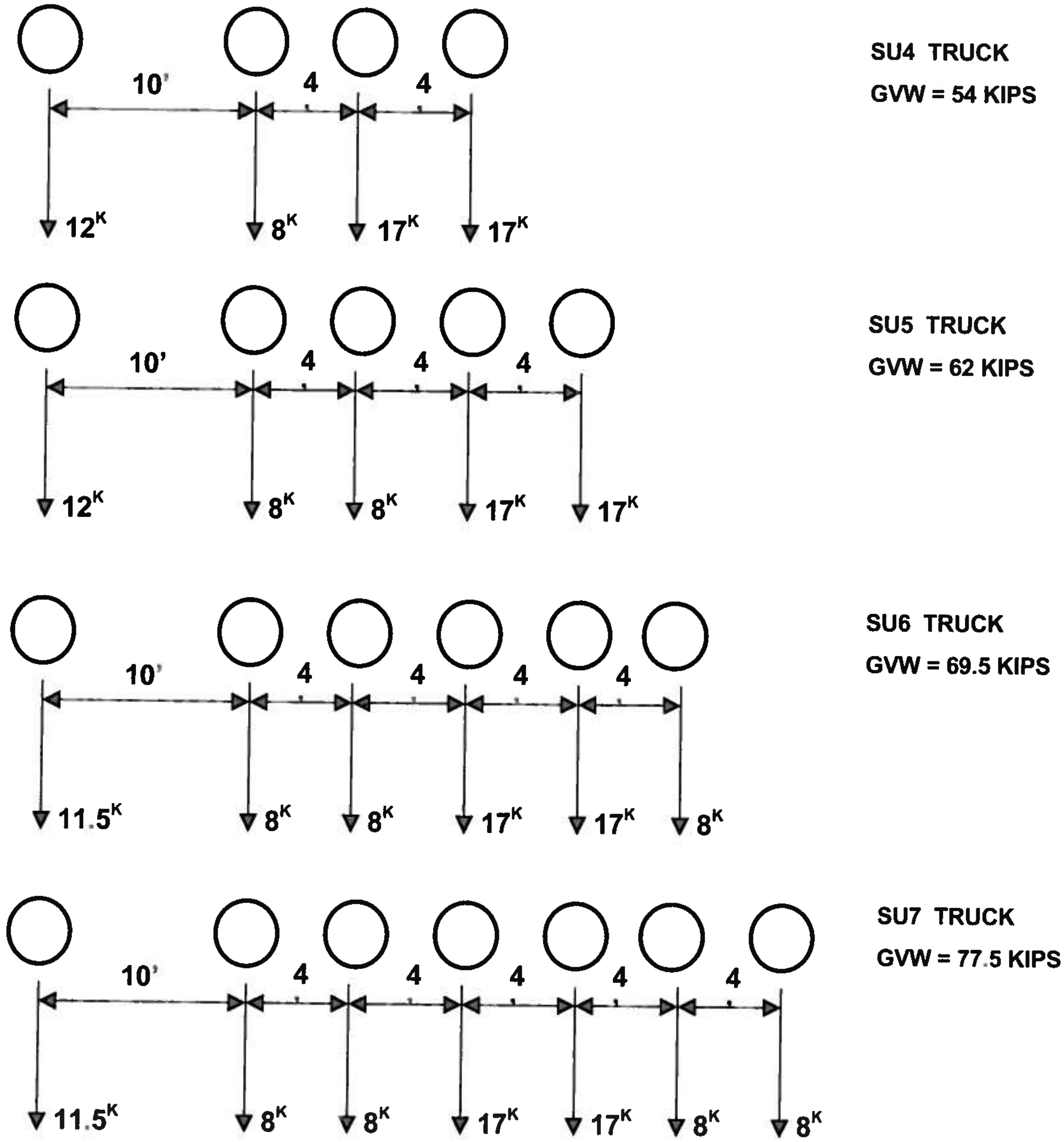
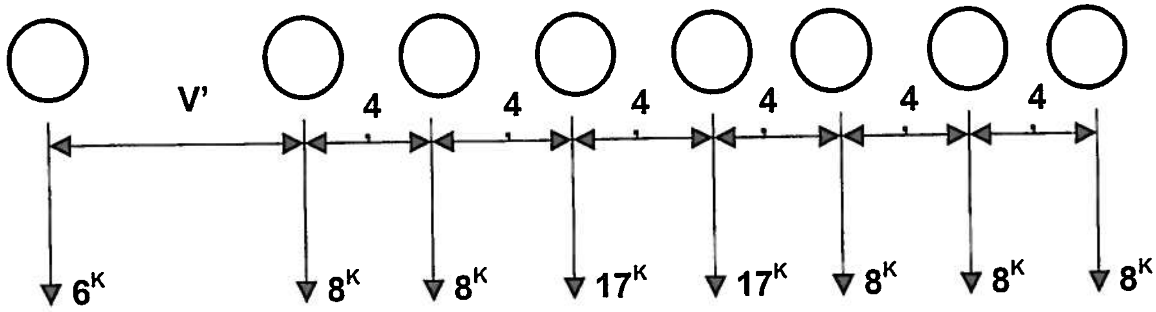



**Figure 6B.7.2-2—Bridge Posting Loads for Single Unit Trucks that Meet Formula B**




V = VARIABLE DRIVE AXLE SPACING — 6'0" TO 14'-0". SPACING TO BE USED IS THAT WHICH PRODUCES MAXIMUM LOAD EFFECTS.

AXLES THAT DO NOT CONTRIBUTE TO THE MAXIMUM LOAD EFFECT UNDER CONSIDERATION SHALL BE NEGLECTED.

MAXIMUM GVW = 80 KIPS

AXLE GAGE WIDTH = 6'-0"

**Figure 6B.7.2-3—Notional Rating Load (NRL) for Single-Unit SHVs that Meet Federal Bridge Formula**

### 6B.7.3—Posting Analysis

The determination of the need to load-post a bridge should be made by the Bridge Owner based on the general procedures in Section 6, Part B, and established practices of the Bridge Owner. When the maximum legal load under State law exceeds the safe load capacity of a bridge calculated at the Operating level, restrictive posting shall be required.

### 6B.7.4—Regulatory Signs

Regulatory signing shall conform to the requirements of the *Manual on Uniform Traffic Control Devices* (MUTCD) or other governing regulations, and shall be established in accordance with the requirements of the agency having authority over the highway.

When a decision is made to close a bridge, signs and properly designed, structurally sound traffic barriers shall be erected to provide adequate warning and protection to the traveling public. If pedestrian travel across the bridge is also restricted, adequate measures to prevent pedestrian use of the bridge shall be installed. Signs and barriers shall meet or exceed the requirements of local laws and the applicable sections of the MUTCD. Bridge closure signs and barriers shall be inspected periodically to ensure their continued effectiveness.